

INDOOR AIR QUALITY ASSESSMENT

**Framingham High School
115 A Street
Framingham, Massachusetts 01701**



Prepared by:
Massachusetts Department of Public Health
Center for Environmental Health
Emergency Response/Indoor Air Quality Program
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Background/Introduction

At the request of parents, the Massachusetts Department of Public Health's (MDPH) Center for Environmental Health (CEH) provided assistance and consultation regarding indoor air quality concerns at Framingham High School (FHS), 115 A Street, Framingham, Massachusetts. On October 13, 2005, Cory Holmes, an Environmental Analyst for CEH's Emergency Response/Indoor Air Quality (ER/IAQ) Program, conducted an assessment of this building. Mr. Holmes was accompanied by John Halliday, Senior Custodian. Complaints of poor airflow, temperature control and concerns related to construction/renovations prompted the request. This report details renovation/construction issues and recommendations that the MDPH believes should be implemented as soon as possible. MDPH staff plan to return to the school to conduct general IAQ testing, which will be addressed in a separate report.

The FHS is a multi-story brick building constructed in the mid-1970s. The improvement project consists of expanding and renovating the existing facility, including new infrastructure, technology upgrades, and electrical, plumbing and mechanical ventilation equipment upgrades. The project began in the summer of 2002 and is scheduled for completion in January of 2005.

Methods

MDPH staff conducted air monitoring to assess whether construction/renovation generated contaminants were migrating into occupied areas of the building. Measurements for ultrafine particles (UFPs) in combination with CO measurements were taken to identify potential pathways of combustion products. Air tests for CO were taken with the TSI, Q-

Trak, IAQ Monitor Model 8551. Air tests for ultrafine particulates were taken with the TSI, P-Trak™ Ultrafine Particle Counter Model 8525. Screening for total volatile organic compounds (TVOCs) was conducted using a Thermo Environmental Instruments Inc., Model 580 Series Photo Ionization Detector (PID).

Results

The school houses approximately 2,000 ninth through twelfth grade students and approximately 250 staff members. Tests were taken at interfaces between construction zones and occupied areas. Tests outside the building and in indoor areas *away* from these interfaces were also taken for comparison. The school was unoccupied at the time; however, construction activities were ongoing as on a typical school/work day. Test results appear in Table 1.

Discussion

Renovations

It is important to note that the State Department of Education amended their regulations in 1999 to address concerns associated with school renovation projects in Massachusetts (MDOE, 1999). Renovation activities can produce a number of pollutants, including dirt, dust, particulates, and combustion products such as CO (i.e., from construction vehicles). CO can produce immediate, acute health effects upon exposure. Particles generated from construction activities can settle on horizontal surfaces in classrooms where they can become re-aerosolized. Particulate matter can be a source of eye and respiratory irritation.

The US Environmental Protection Agency (US EPA) has established National Ambient Air Quality Standards (NAAQS) for exposure to carbon monoxide in outdoor air. Carbon monoxide levels in outdoor air must be maintained below 9 ppm over a twenty-four-hour period in order to meet this standard (US EPA, 2000). *Carbon monoxide should not be present in a typical, indoor environment.* If it is present, indoor carbon monoxide levels should be less than or equal to outdoor levels. On the day of assessment, outdoor carbon monoxide concentrations were non-detect (ND) (Table 1). Carbon monoxide levels measured in the school were also ND (Table 1).

The combustion of fossil fuels, welding, steel cutting, concrete/brick boring and other renovation activities can produce particulate matter that is of a small diameter [<10 micrometers (μm)], which can penetrate into the lungs and subsequently cause irritation. For this reason a device that can measure ultra fine particles (UFPs), particles of a diameter of $10\ \mu\text{m}$ or less, was used to identify pollutant pathways from the renovation site into occupied areas.

The instrument used by MDPH staff to conduct air monitoring for UFPs counts the number of particles that are suspended in a cubic centimeter (cm^3) of air. This type of air monitoring is useful in that it can track and identify the source of airborne pollutants by counting the actual number of airborne particles. The source of particle production can be identified by moving the UFP counter through a building towards the highest measured concentration of airborne particles. Measured levels of particles/ cm^3 of air increase as the UFP counter is moved closer to the source of particle production.

The primary purpose of these tests at the school was *to identify and reduce/prevent pollutant pathways*. Air monitoring for UFPs was conducted in areas that may be directly

impacted due to close proximity to renovation sites. As previously mentioned, comparison measurements were taken in indoor and outdoor (i.e., background) areas away from renovation sites. Levels of UFPs higher than background levels were measured around containment walls in several areas (Table 1). Breaches were observed around construction barriers from which drafts could be felt and/or light was seen penetrating (Pictures 1 and 2).

Other IAQ Evaluations

Indoor air quality can also be negatively influenced by the presence of materials containing volatile organic compounds (VOCs). VOCs are carbon-containing substances that have the ability to evaporate at room temperature. Exposure to low levels of total VOCs (TVOCs) may produce eye, nose, throat and/or respiratory irritation in some sensitive individuals. For example, chemicals evaporating from a paint can stored at room temperature would most likely contain VOCs.

In an effort to determine whether VOCs were present in the building, air monitoring for TVOCs was conducted. An outdoor air sample was taken for comparison. Outdoor TVOC concentrations were ND (Table 1). Indoor TVOC concentrations were also ND (Table 1), with the exception of the chemical storeroom C 114. Measurable levels of TVOCs were recorded at 37 parts per million (ppm) upon opening the “corrosives” locker (Pictures 3 and 4). The source appeared to be from several bottles of acid with damaged caps. Upon closer scrutiny, cracks in the caps and acidic crystal formation were

observed on the containers (Pictures 5 and 6). In addition, the label had become corroded, making it difficult to identify the materials (Picture 5).

A number of other conditions that can affect indoor air quality were noted in the chemical storeroom:

- A number of materials appear to be very old.
- Items were labeled with chemical formula instead of the chemical name (Picture 7).
- Flasks containing chemicals were sealed with parafilm (Picture 8), glass or rubber stoppers. The sealing of these containers can lead to the slow evaporation of materials.
- Several materials were seen stored in laboratory chemical hoods (Picture 9). Stock bottles of chemicals should be returned to chemical storage areas once experiments have been completed.

It is highly recommended that a thorough inventory of chemicals in the chemical storeroom and science department be conducted to determine whether chemical storage and disposal is conducted in an appropriate manner, consistent with Massachusetts hazardous waste laws.

Conclusions/Recommendations

A number of pathways were identified for pollutants to move from areas under renovation into occupied spaces. These pathways indicate that the containment measures at the time of the assessment were not sufficient to contain pollutants related to renovation work. The following recommendations should be implemented in order to reduce the

migration of renovation-generated pollutants into occupied areas and the potential impact on indoor air quality:

1. Comply with 603 CMR 38.00: School Construction – Massachusetts Department of Education. This regulation states that “[a]pplicants shall implement containment procedures for dusts, gases, fumes, and other pollutants created during renovations/construction as part of any planned construction, addition to, or renovation of a school if the building is occupied by students, teachers or school department staff while such renovation and construction is occurring. Such containment procedures shall be consistent with the most current edition of the IAQ Guidelines for Occupied Buildings Under Construction published by the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA). All bids received for school construction or renovations shall include the cost of planning and execution of containment of construction/renovation pollutants consistent with the SMACNA guidelines [608 CMR 38.03(13)] General Requirements: Capital Construction” (MDOE, 1999).
2. Seal construction barriers on all sides with polyethylene plastic and duct tape. Seal these barriers on the construction, as well as the occupied side to provide a dual barrier. Ensure integrity of barriers by monitoring for light penetration and drafts around seams.
3. Develop a notification system to provide building occupants immediately adjacent to construction activities a means to report construction/renovation related odors and/or dusts problems to the building administrator. Have these concerns relayed to the contractor in a manner to allow for a timely remediation of the problem.

4. Continue to schedule projects that produce large amounts of dusts, odors and emissions during unoccupied periods or periods of low occupancy.
5. Cover dirt/debris piles with tarps or wet down to decrease aerosolization of particulates, when possible.
6. Ensure faculty are aware of construction activities that may be conducted in close proximity to their classrooms. In certain cases, HVAC equipment and windows to classrooms adjacent to construction activities may need to be deactivated/closed periodically to prevent unfiltered air and vehicle exhaust from entering the building. For this reason, prior notification(s) should be made.
7. Disseminate scheduling itinerary to all affected parties through meetings, newsletters and/or weekly bulletins.
8. Continue to monitor Material Safety Data Sheets (MSDS) for all construction materials used during renovations and keep them in an area that is accessible to all individuals during periods of building operations as required by the Massachusetts Right-To-Know Act (MGL, 1983). Provide proper ventilation and allow sufficient curing time as per the manufacturer's instructions concerning these materials.
9. Use local exhaust ventilation and isolation techniques to control for renovation pollutants. Precautions should be taken to avoid the *re-entrainment* of these materials into the building's HVAC system. The design of each system must be assessed to determine how it may be impacted by renovation activities. Specific HVAC protection requirements pertain to the return, central filtration and supply components of the ventilation system. This may entail shutting down systems (when possible) during periods of heavy construction and demolition, ensuring

systems are isolated from contaminated environments, sealing ventilation openings with plastic and utilizing filters with a higher dust spot efficiency where needed (SMACNA, 1995).

10. Relocate susceptible persons and those with pre-existing medical conditions (e.g., hypersensitivity, asthma) away from areas of renovations, if possible.
11. Implement prudent housekeeping and work site practices to minimize exposure to renovation pollutants. Consider increasing the number of full-time equivalents or work hours for existing staff (e.g., before school) to accommodate increase in dirt, dust accumulation due to construction/renovation activities. To control for dusts, a high efficiency particulate air filter (HEPA) equipped vacuum cleaner in conjunction with wet wiping/mopping of all surfaces is recommended.
12. Consider changing HVAC filters more regularly in areas impacted by renovation activities. Examine the feasibility of acquiring more efficient filters for these units.
13. Conduct a chemical inventory in the chemical storage room and science labs. Properly store flammable materials in a manner consistent with the local fire code. Discard hazardous materials or empty containers of hazardous materials in a manner consistent with environmental statutes and regulations. Label chemical containers with the chemical name of its contents. Follow proper procedures for storing and securing hazardous materials.

References

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Picture 1



Longview of Gypsum Wallboard Construction Barrier

Picture 2



Close-Up of Spaces around Gypsum Wallboard Construction Barrier from which Light Could be Seen Penetrating and Drafts Could be Felt

Picture 3



Corrosives Cabinet in Chemical Storeroom C 113

Picture 4



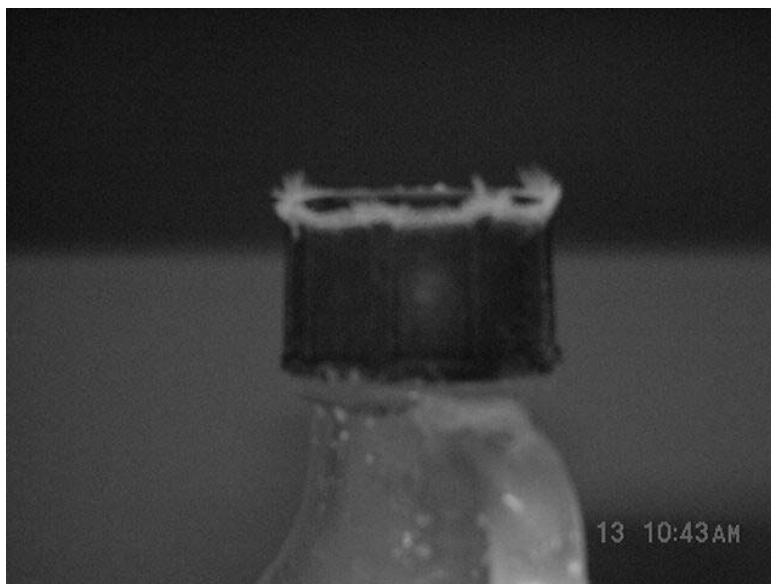
Interior of Corrosives Locker, Note Corrosion and Splashed Pattern of Material on inside of Door

Picture 5



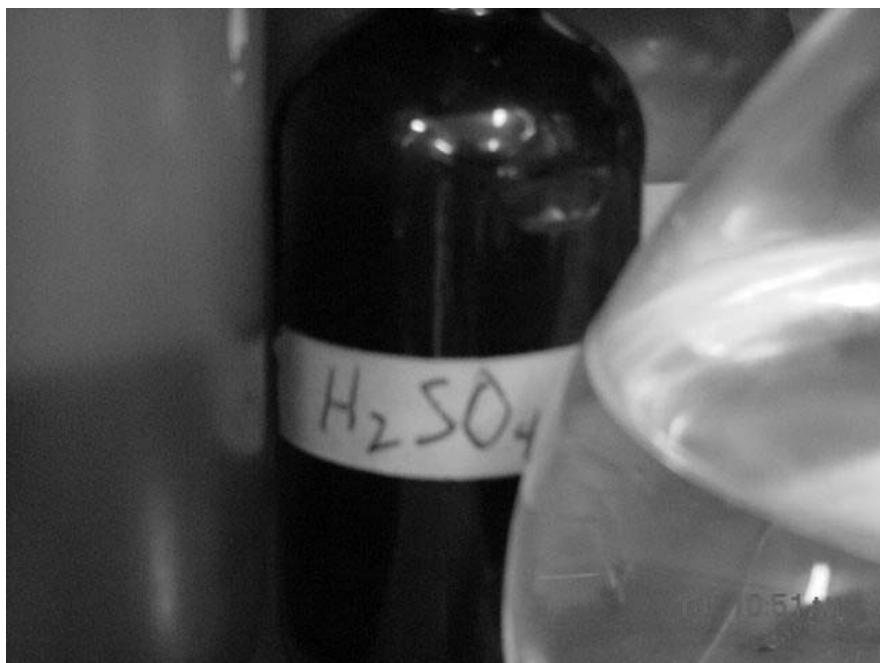
Bottle of Acid with Broken Cap in Corrosives Locker, Note Crystallization on Cap, Corroded Label and Debris on Shelf around Bottle

Picture 6



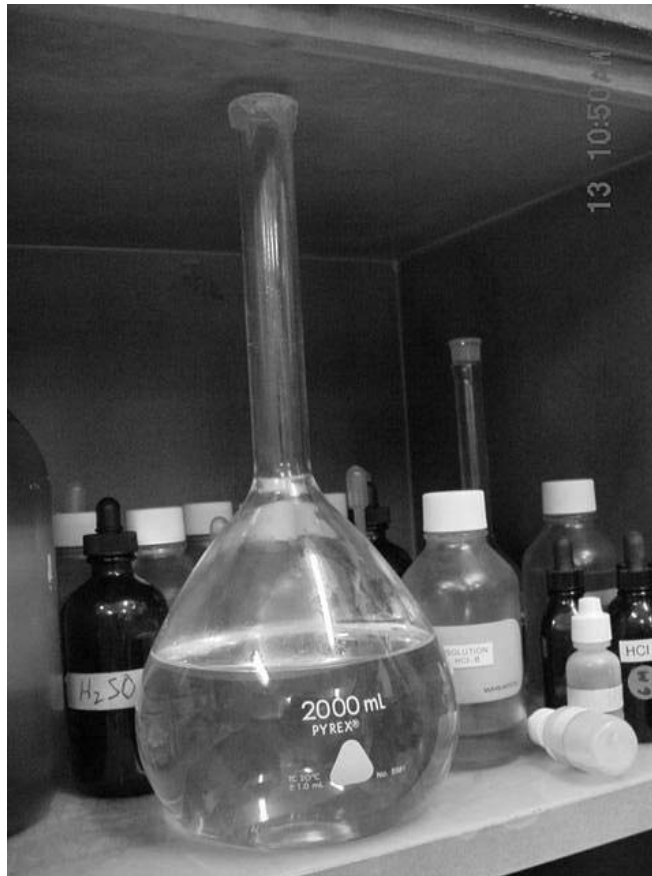
Broken Acid Cap with Crystallization in Corrosives Locker

Picture 7



Bottle Labeled with Chemical Formula

Picture 8



Chemical Flask Sealed with Parafilm

Picture 9



Chemicals Stored in Lab Hood

TABLE 1**Indoor Air Test Results – Framingham High School, Framingham, MA – October 13, 2005**

Location	Carbon Monoxide (*ppm)	TVOCs (*ppm)	Ultrafine Particulates (**1000p/cc³)	Remarks
Background	ND	ND	6.5-7	
C114 Chemical Storeroom Center of Room	ND	ND		
C114 at open Corrosives Cabinet	ND	37		Broken acid caps-crystallization of acids on bottles, strong odors, corrosion of interior of cabinets
E214 Hallway	ND	ND	4.9	
E214 Hallway at Construction Barrier	ND	ND	12-16	Elevated UFCs around seams of construction barrier-drafts/light penetrating
E118 Hallway	ND	ND	4.7	
E118 Hallway at Construction Barrier	ND	ND	15	Elevated UFCs around seams of construction barrier-drafts/light penetrating
H108 Hallway	ND	ND	4.5	
H108 Hallway at Construction Barrier	ND	ND	7.4	Elevated UFCs around seams of construction barrier-drafts/light penetrating

*** ppm = parts per million**

****1000p/cc³ = parts per cubic centimeter**

TABLE 1

Indoor Air Test Results – Framingham High School, Framingham, MA – October 13, 2005

Location	Carbon Monoxide (*ppm)	TVOCs (*ppm)	Ultrafine Particulates (**1000p/cc³)	Remarks
Kitchen Loading Dock Hallway	ND	ND	5.2	Asbestos remediation behind door (sealed inside/negative ventilation), signage posted
Kitchen Loading Dock Hallway around Door	ND	ND	4.9	Recommend sealing on outside as well for duel barrier

*** ppm = parts per million**

****1000p/cc³= parts per cubic centimeter**